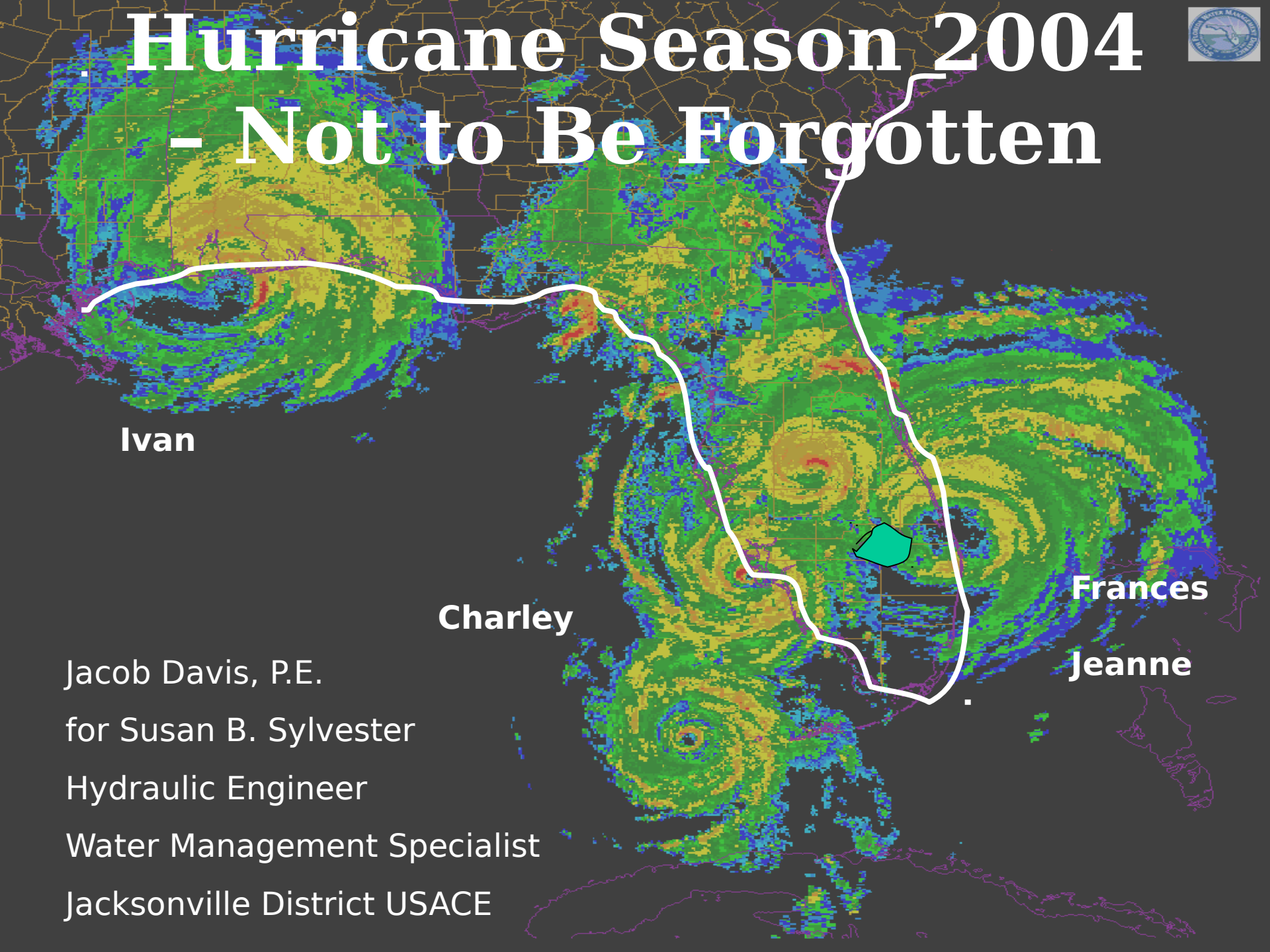
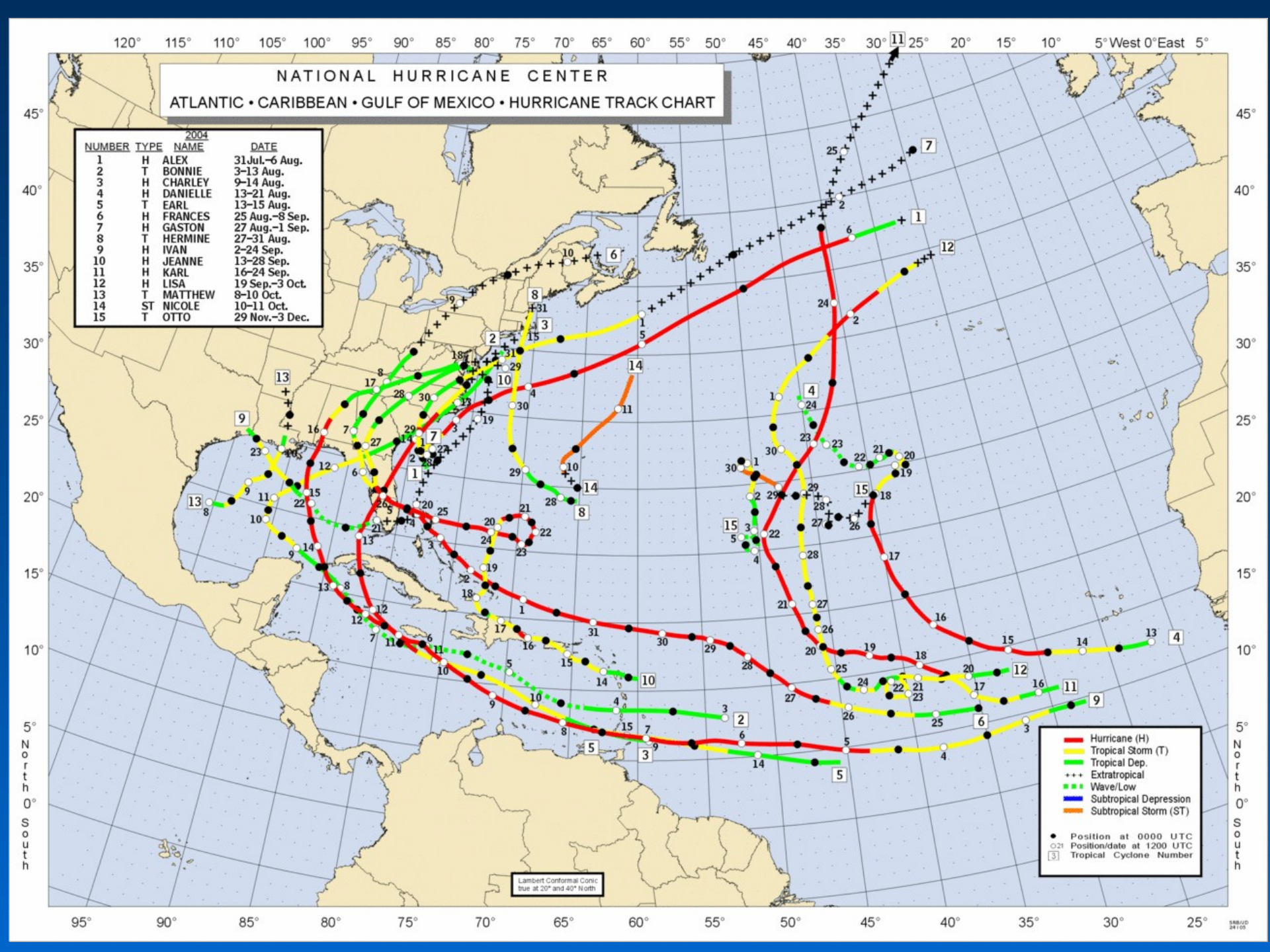
Hurricane Season 2004 - Not to Be Forgotten

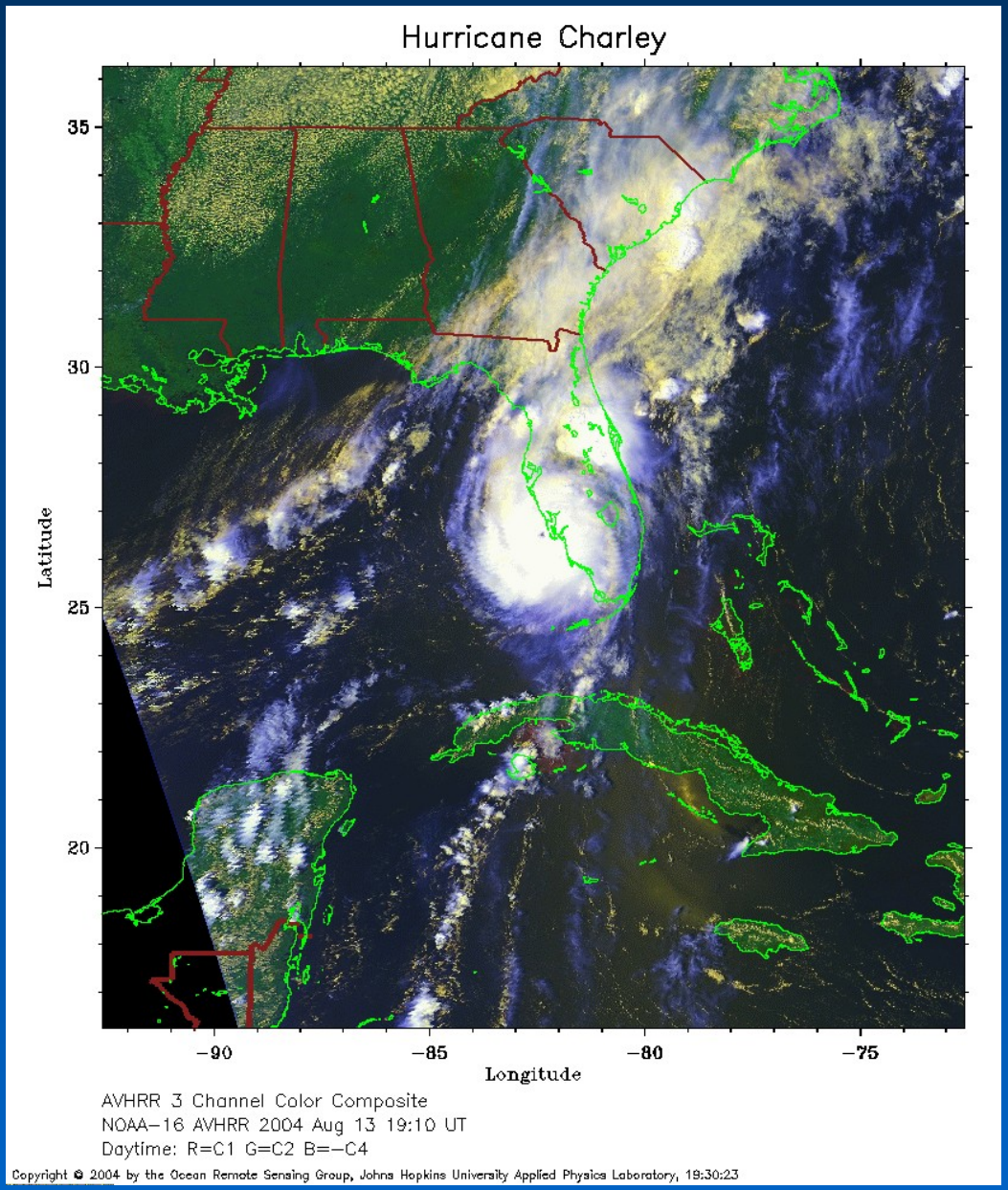


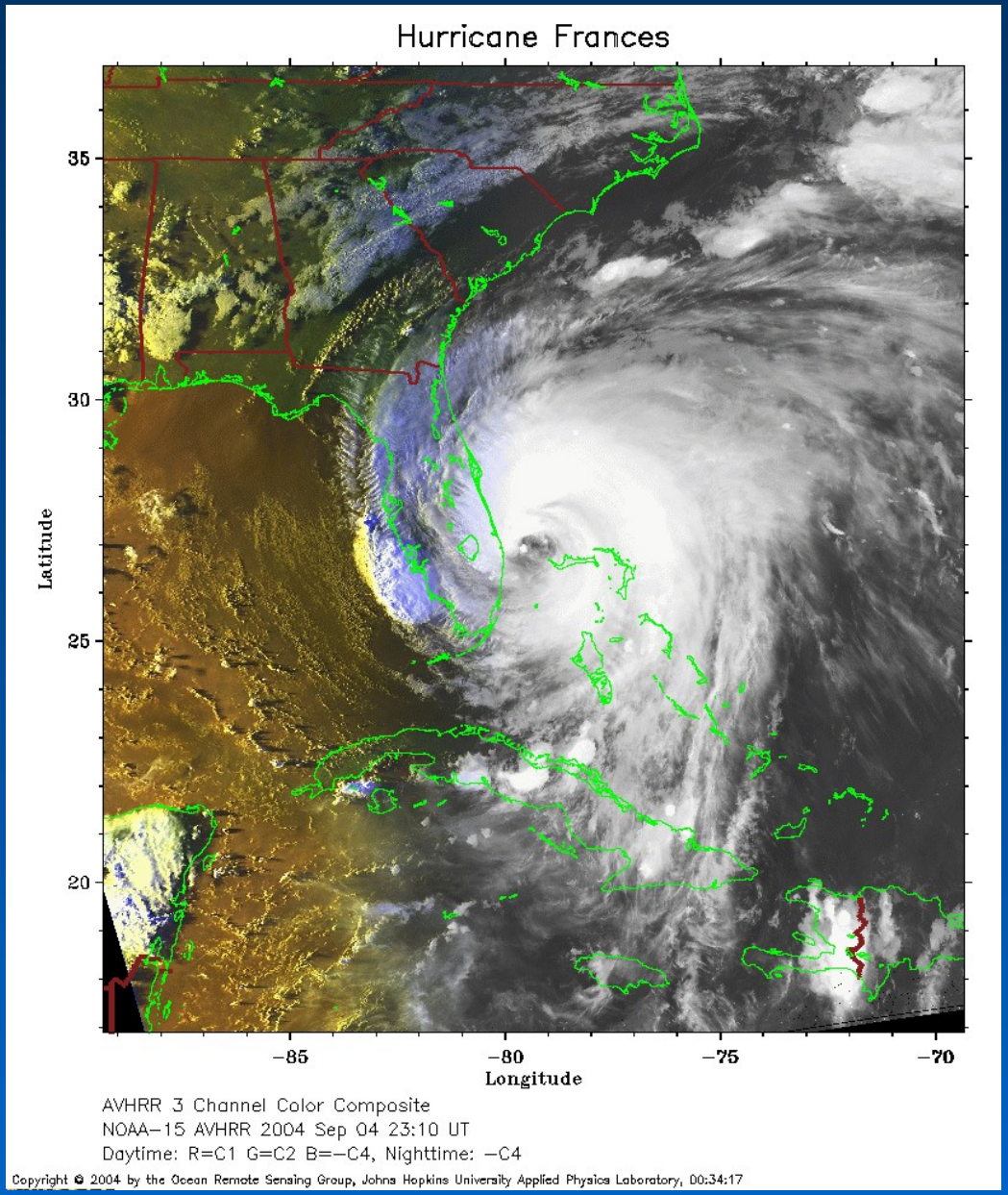
Jacob Davis, P.E.
for Susan B. Sylvester
Hydraulic Engineer
Water Management Specialist
Jacksonville District USACE

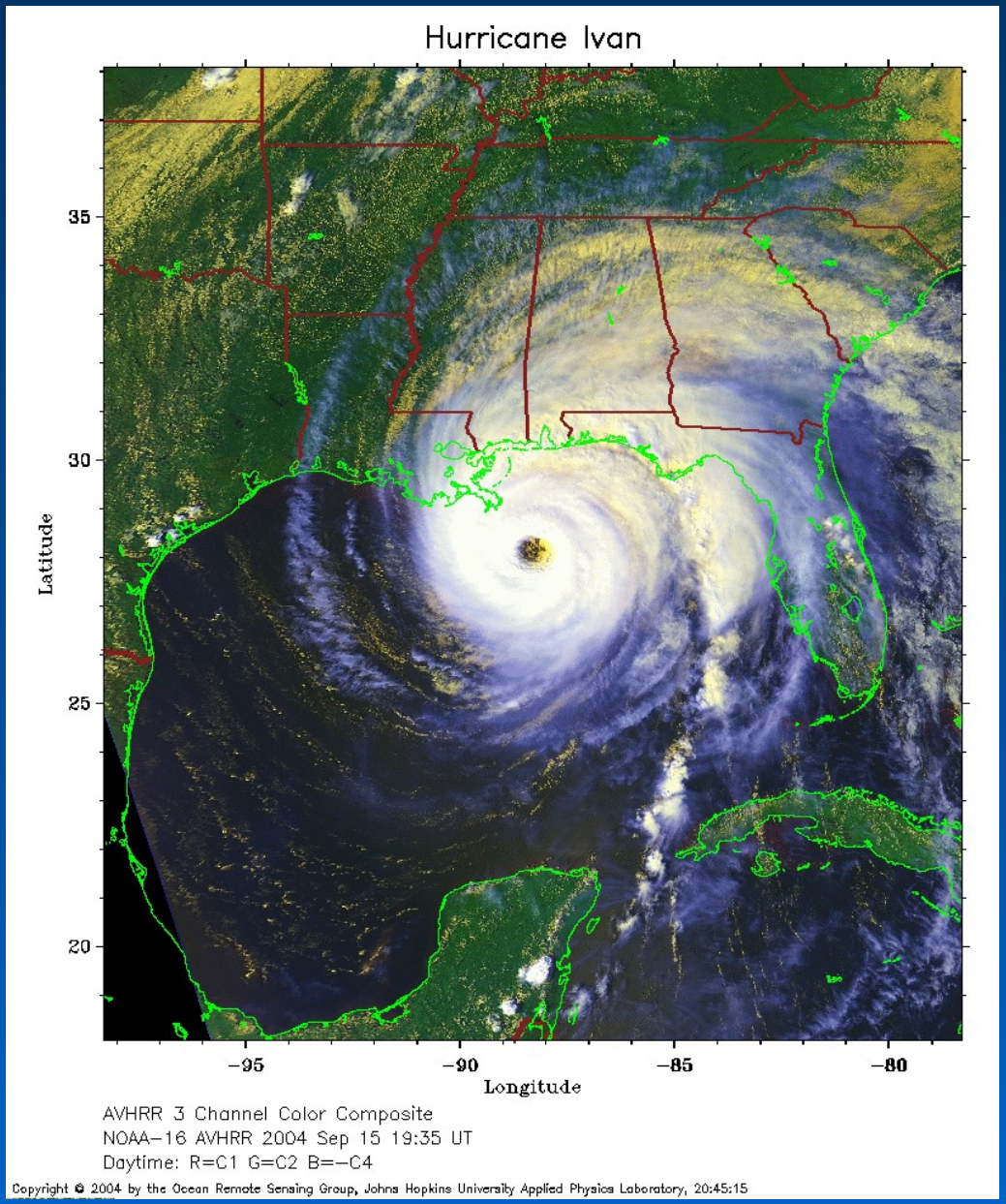

NATIONAL HURRICANE CENTER
ATLANTIC • CARIBBEAN • GULF OF MEXICO • HURRICANE TRACK CHART
2004
NUMBER TYPE NAME DATE
1 H ALEX 31Jul.–6 Aug.
2 T BONNIE 3–13 Aug.
3 H CHARLEY 9–14 Aug.
4 H DANIELLE 13–21 Aug.
5 T EARL 13–15 Aug.
6 H FRANCES 25 Aug.–8 Sep.
7 H GASTON 27 Aug.–1 Sep.
8 T HERMINE 27–31 Aug.
9 H IVAN 2–24 Sep.
10 H JEANNE 13–28 Sep.
11 H KARL 16–24 Sep.
12 H LISA 19 Sep.–3 Oct.
13 T MATTHEW 8–10 Oct.
14 ST NICOLE 10–11 Oct.
15 T OTTO 29 Nov.–3 Dec.
Hurricane (H)
Tropical Storm (T)
Tropical Dep.
Extratropical
Wave/Low
Subtropical Depression
Subtropical Storm (ST)
Position at 0000 UTC
Position/date at 1200 UTC
Tropical Cyclone Number
Lambert Conformal Conic
true at 20° and 40° North
120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° West 0° East 5°
45° 40° 35° 30° 25° 20° 15° 10° 5° North 0° South
95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25°

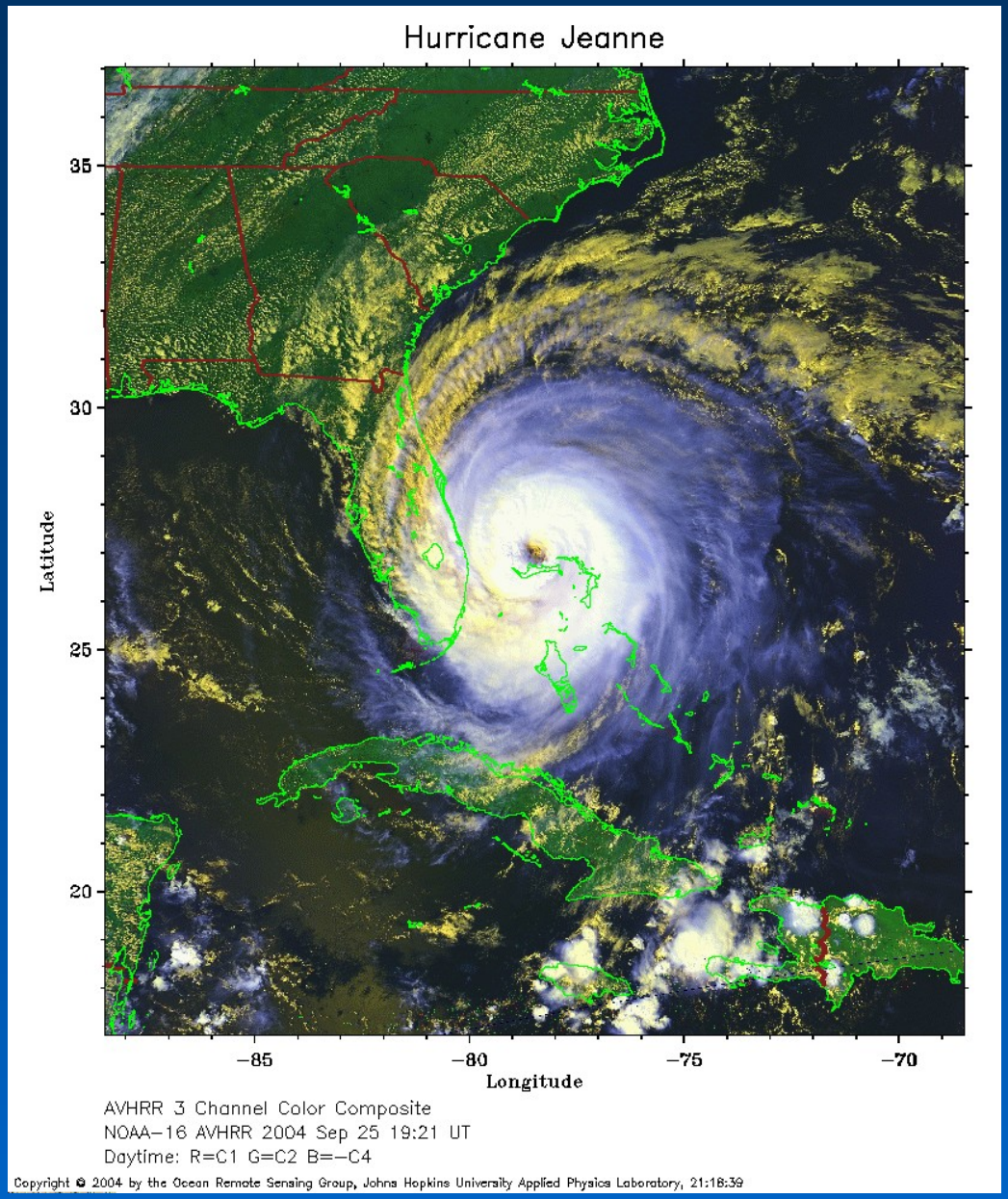
The 2004 Atlantic Hurricane Season

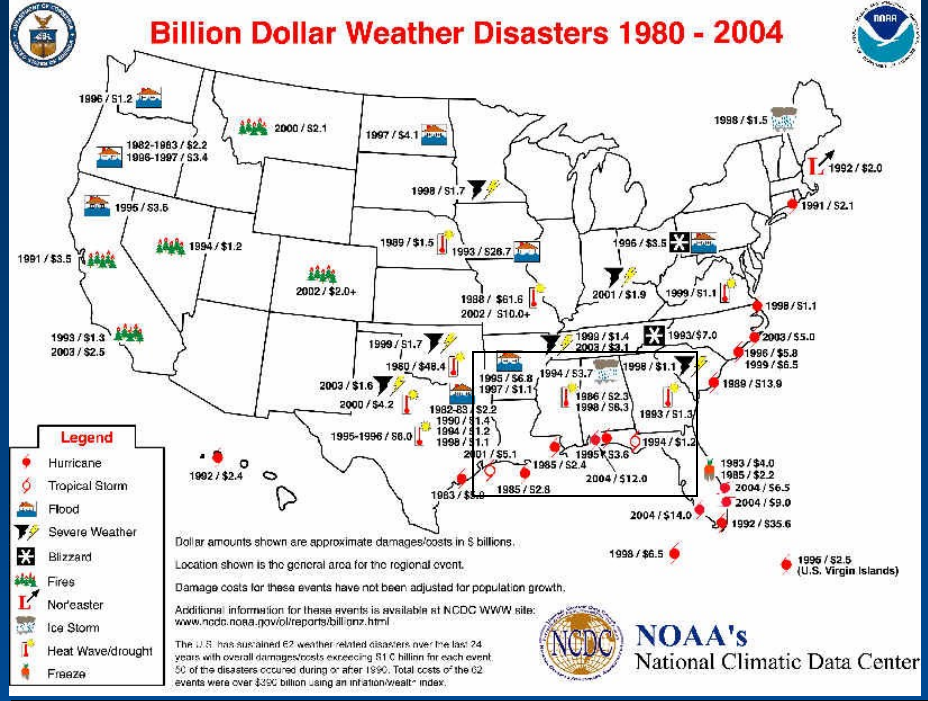
Alex	
TS Bonnie	13 August
Charley	
Danielle	
TS Earl	4 September
Frances	
TS Gaston	
TS Hermine	Return 14 September
Ivan	
Jeanne	Jeanne 25 September
Karl	
Lisa	
TS Matthew	


Hurricane Charley
35
30
25
20
Latitude
−90
−85
−80
−75
Longitude
AVHRR 3 Channel Color Composite
NOAA−16 AVHRR 2004 Aug 13 19:10 UT
Daytime: R=C1 G=C2 B=−C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 19:30:23


Hurricane Frances
35
30
25
20
Latitude
−85
−80
−75
−70
Longitude
AVHRR 3 Channel Color Composite
NOAA−15 AVHRR 2004 Sep 04 23:10 UT
Daytime: R=C1 G=C2 B=−C4, Nighttime: −C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 00:34:17


Hurricane Ivan
35
30
25
20
Latitude
−95
−90
−85
−80
Longitude
AVHRR 3 Channel Color Composite
NOAA−16 AVHRR 2004 Sep 15 19:35 UT
Daytime: R=C1 G=C2 B=−C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 20:45:15

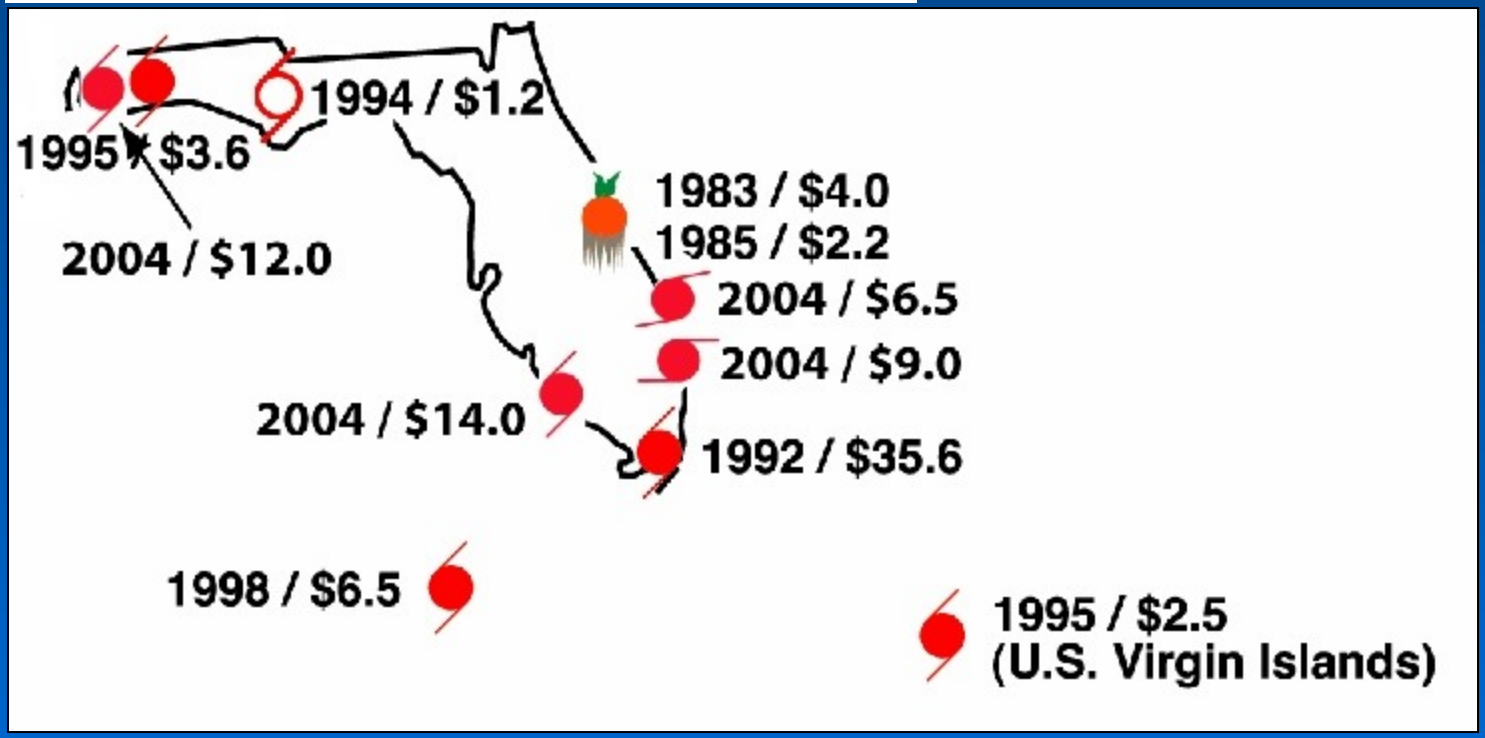

Hurricane Jeanne
35
30
25
20
Latitude
−85
−80
−75
−70
Longitude
AVHRR 3 Channel Color Composite
NOAA−16 AVHRR 2004 Sep 25 19:21 UT
Daytime: R=C1 G=C2 B=−C4
Copyright © 2004 by the Ocean Remote Sensing Group, Johns Hopkins University Applied Physics Laboratory, 21:18:39



4 hit Florida within ~6 weeks, 3 were major hurricanes;

117 lives lost, 1 in 5 homes damaged or destroyed,

Est. property damage ~$42B



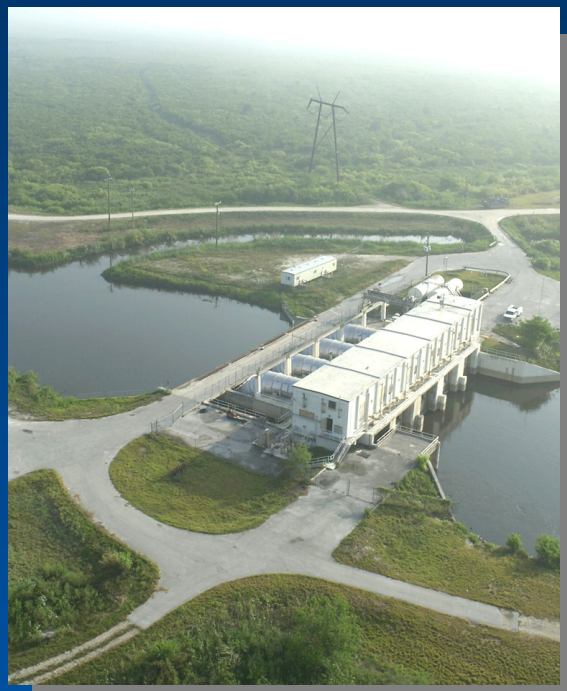
http://www.ncdc.noaa.gov/img/climate/research/2004/sep/frances-landf

Atlantic Hurricane Season (Jun 1 – Nov 30)

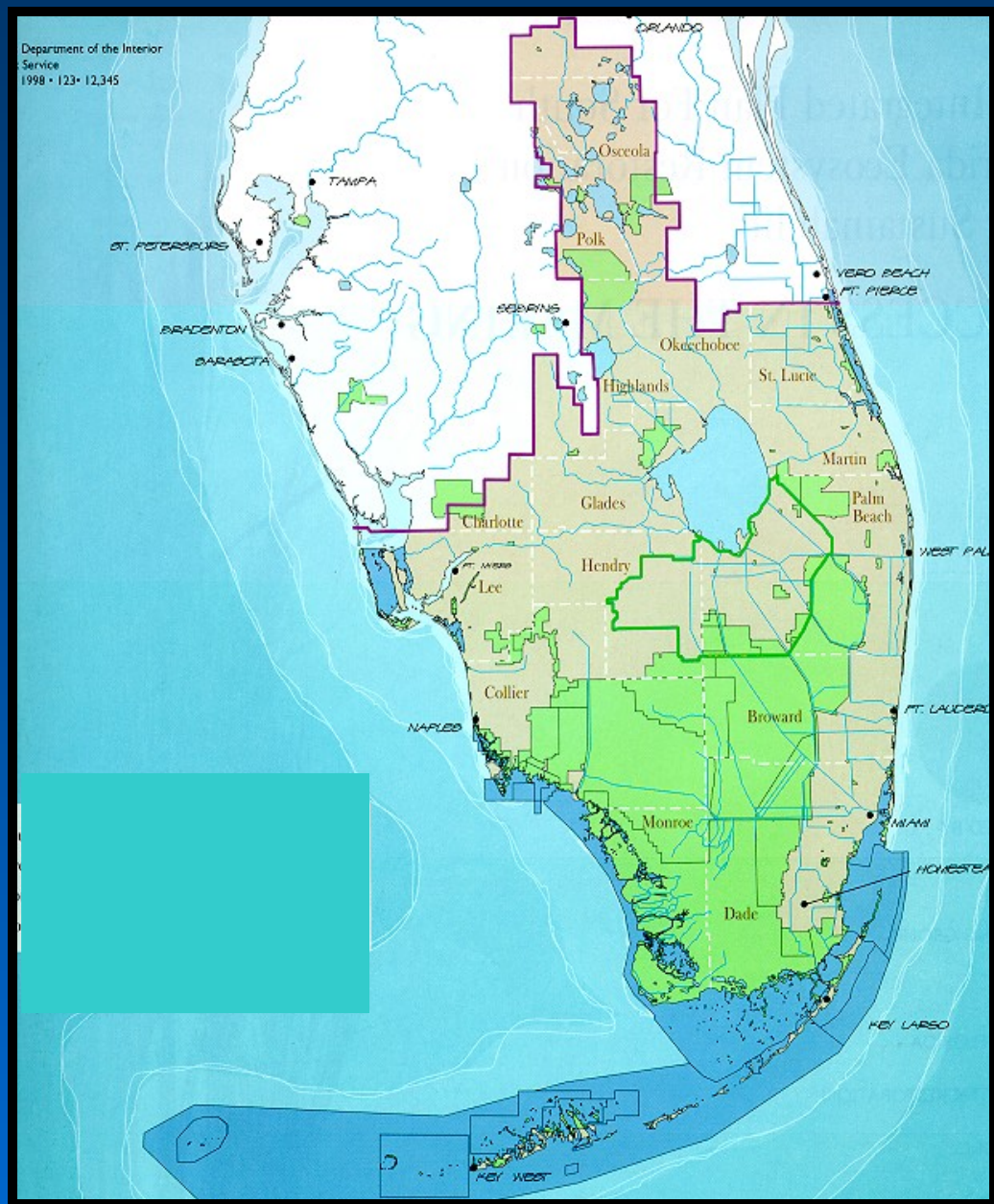
	Average[1]	NOAA 2004 Initial Forecast	2004 Actual	NOAA 2005 Initial Forecast	CSU (Dr. Gray) Initial '05 Forecast[4]
Tropical Storms	**10**	**12-15**	**15**	**12-15**	**13**
Hurricanes	**6**	**6-8**	**9[2]**	**7-9**	**7**
Major Hurricanes (winds > 111 mph)	**2**	**2-4**	**6[3]**	**3-5**	**3**

(1) 8 of past 10 seasons were above average
(2) 4 hit Florida within ~6 weeks, 3 were major hurricanes;
(117 lives lost, 1 in 5 homes damaged or destroyed, est. property damage ~$42B (msnbc.nsn.com/id/7872376)
(3) Alex, Charley, Frances, Ivan, Jeanne, Karl
(4) to be updated 31May – likely to be increased due to lack of strong El Nino &

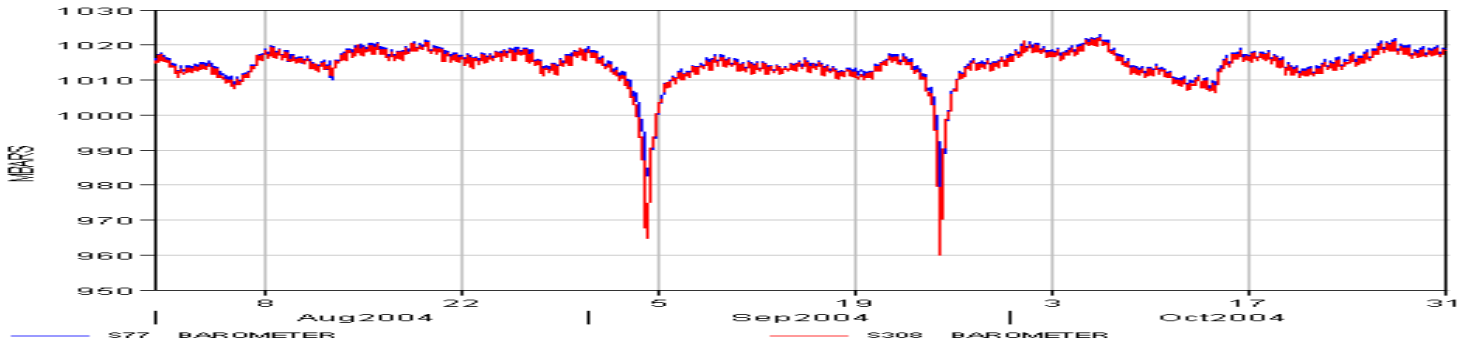
South Florida Water System

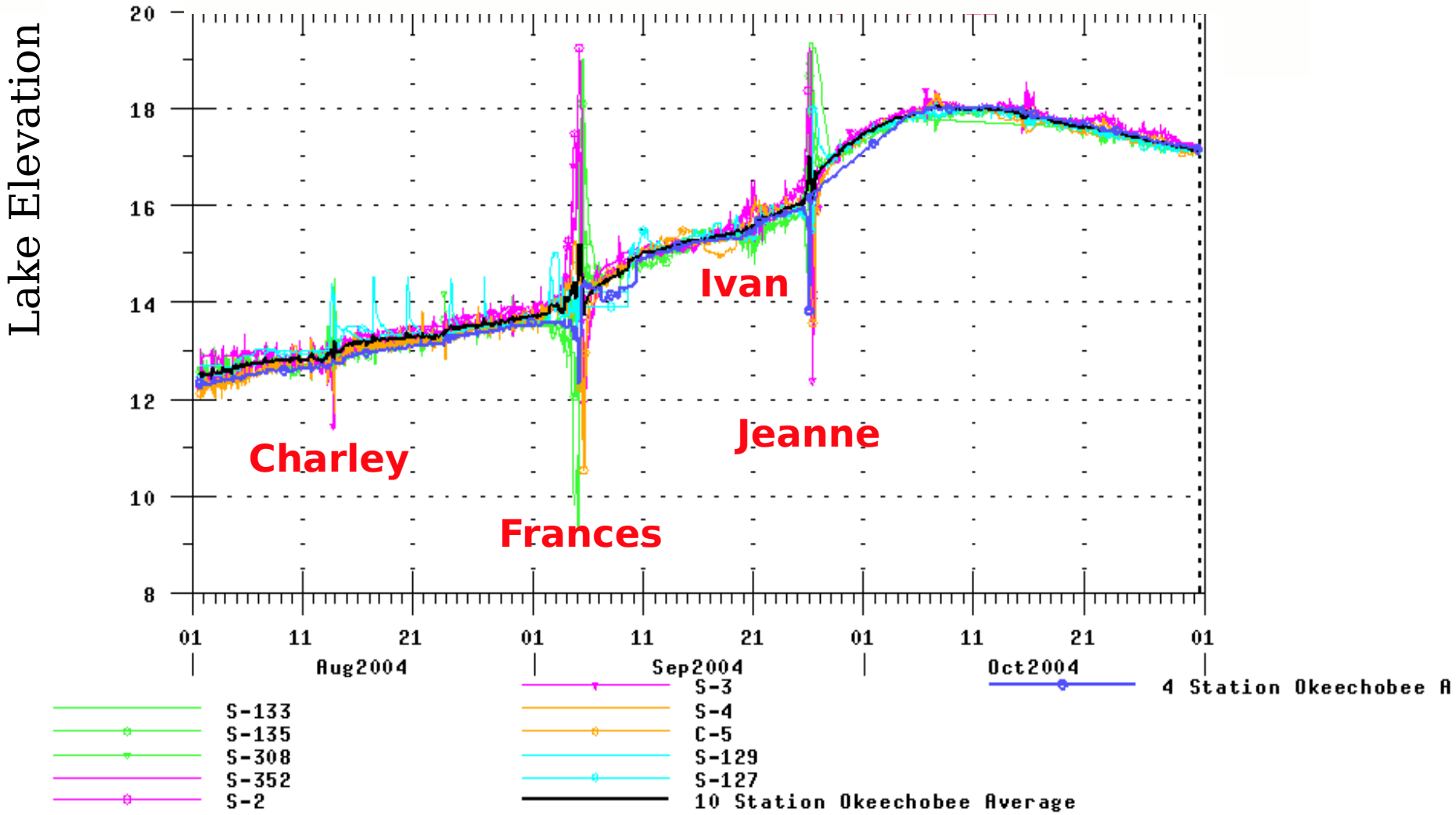


- **18,000 Square Miles**
- **Highly managed system**
- **6.5 Million people**
- **Multi-Billion Dollar economy focused on**



- 2nd Largest FW Lake in US
- 143 Miles Earthen Dike (HHD)
- 5 Spillway Outlets
- 5 Spillway Inlets
- 17 Primary Culverts
- 12 Secondary Culverts
- 9 Locks


MBARS
1030
1020
1010
1000
990
980
970
960
950
8
22
5
19
3
17
31
Aug2004
Sep2004
Oct2004
S77 BAROMETER
S308 BAROMETER


Lake Elevation
20
18
16
14
12
10
8
Charley
Frances
Ivan
Jeanne
01
11
21
01
11
21
01
11
21
01
Aug2004
Sep2004
Oct2004
S-133
S-135
S-308
S-352
S-2
S-3
S-4
C-5
S-129
S-127
10 Station Okeechobee Average
4 Station Okeechobee A

Surge Animation

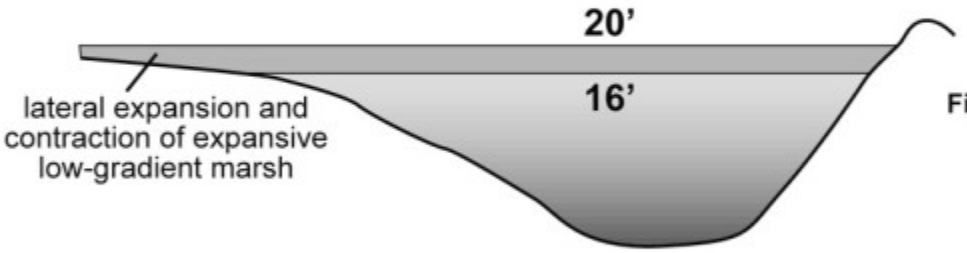
Courtesy COMET Program

11/30/2004

11/30/2004

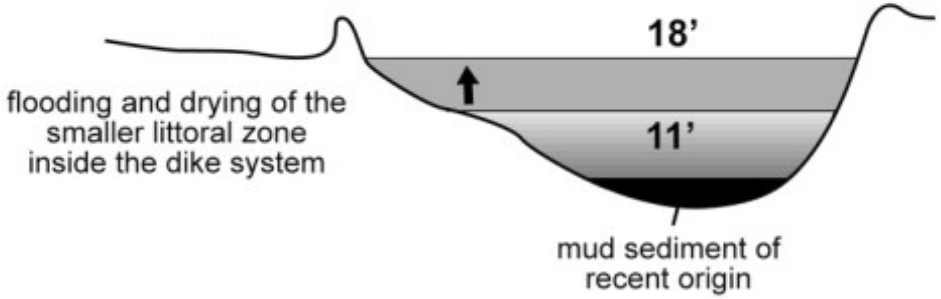
11/30/2004

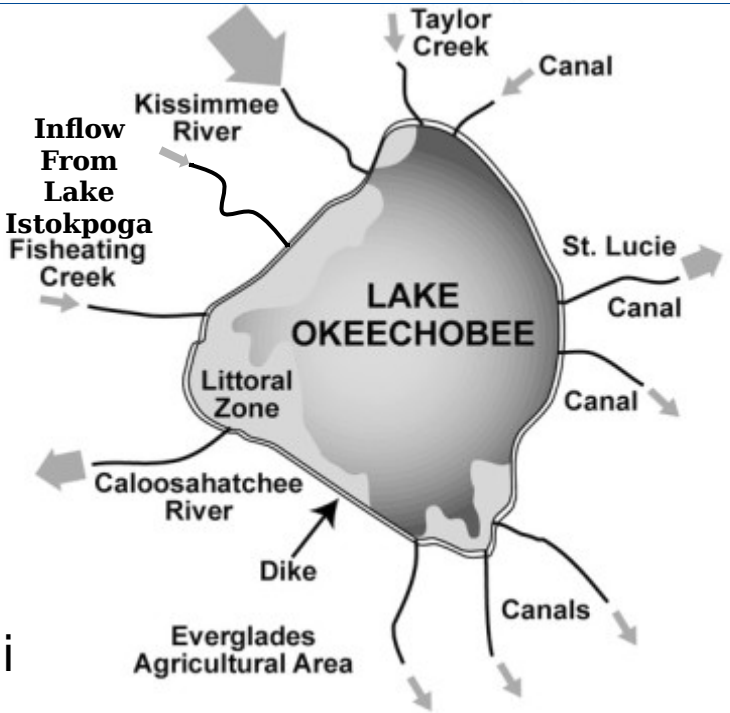
PAST



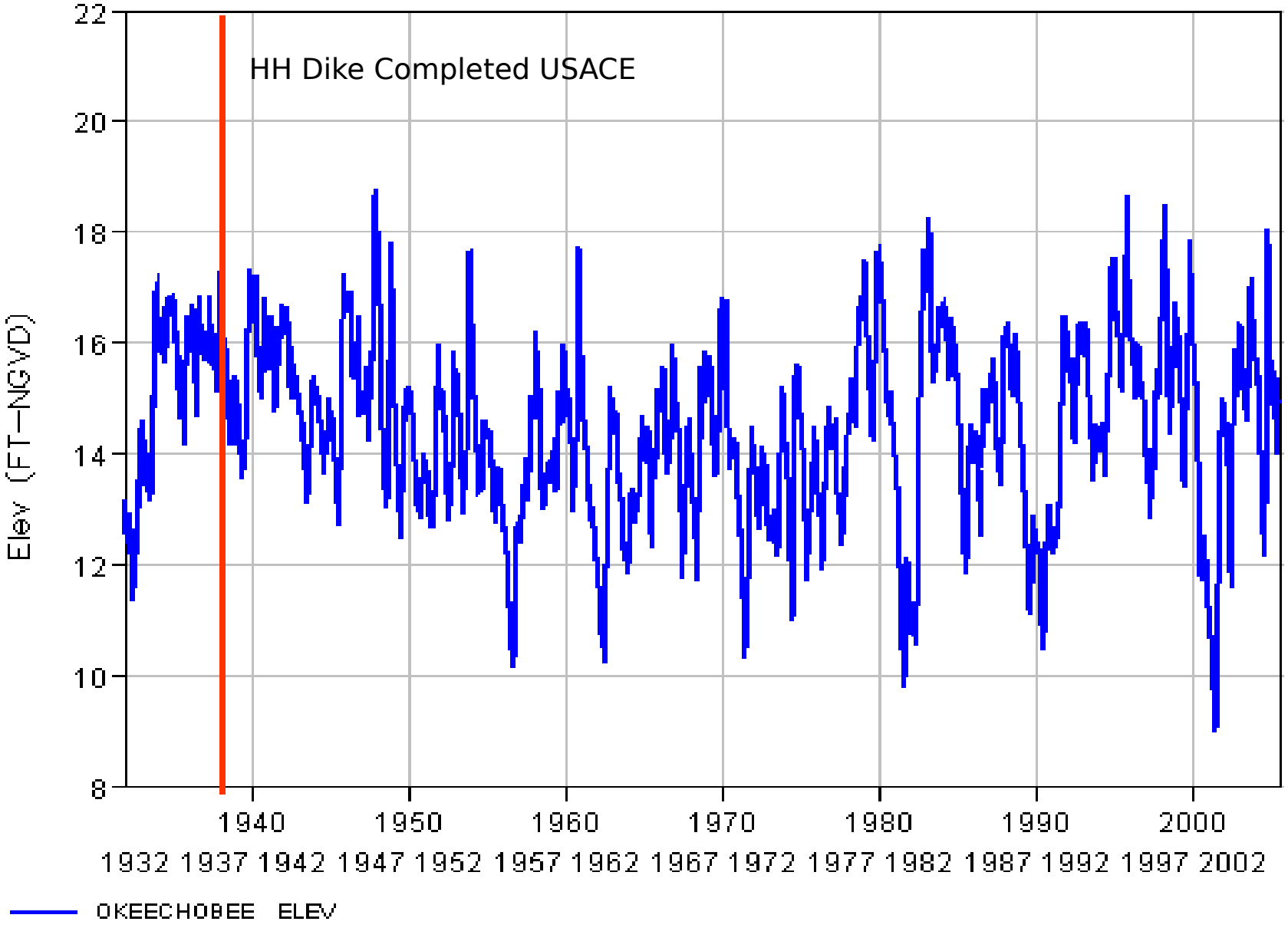
~1200 sq mi

PRESENT





730 sq mi

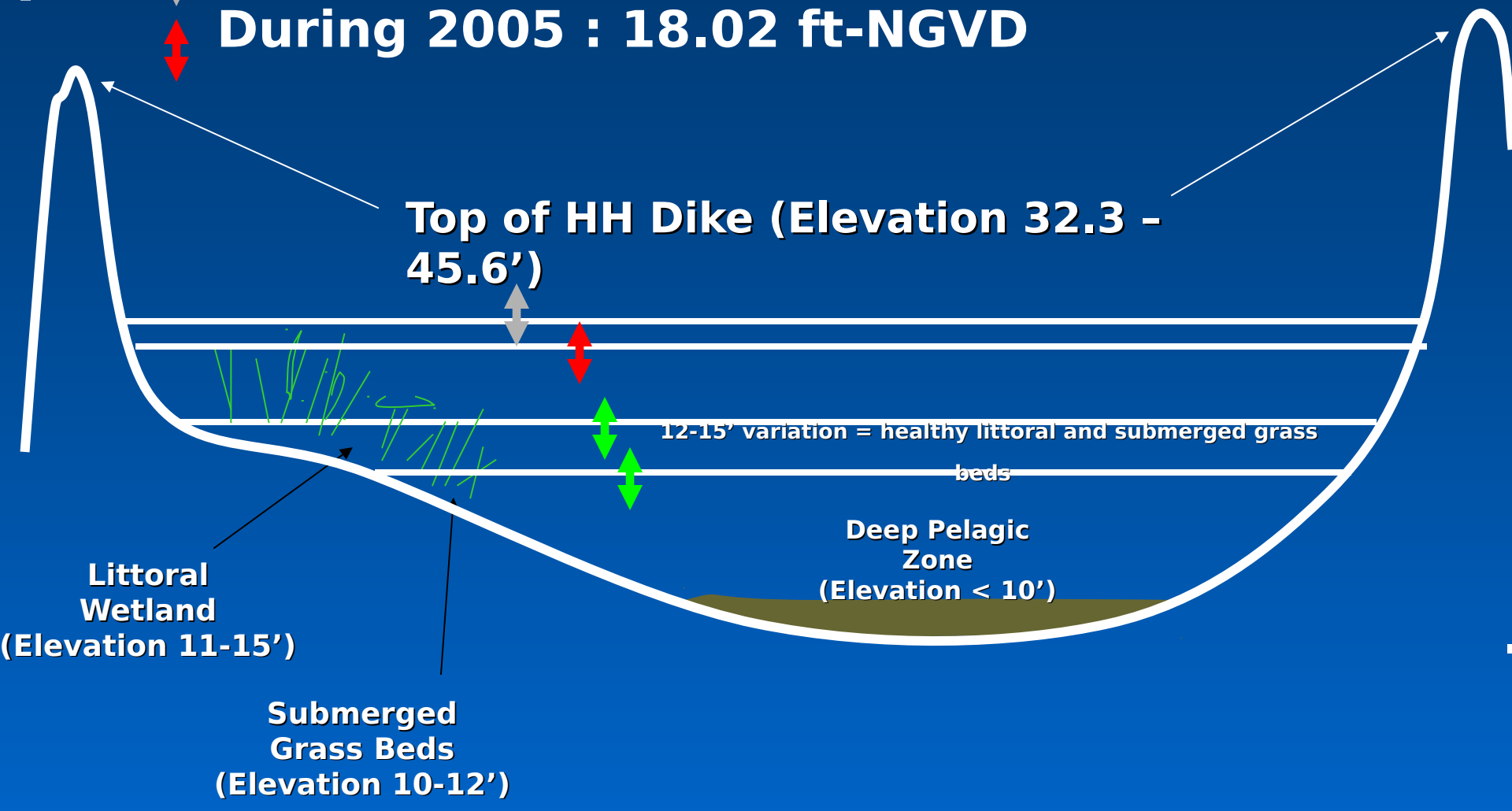

HH Dike Completed USACE
Elev (FT-NGVD)
22
20
18
16
14
12
10
8
1940
1950
1960
1970
1980
1990
2000
1932 1937 1942 1947 1952 1957 1962 1967 1972 1977 1982 1987 1992 1997 2002
OKEECHOBEE ELEV

Ranges of water levels

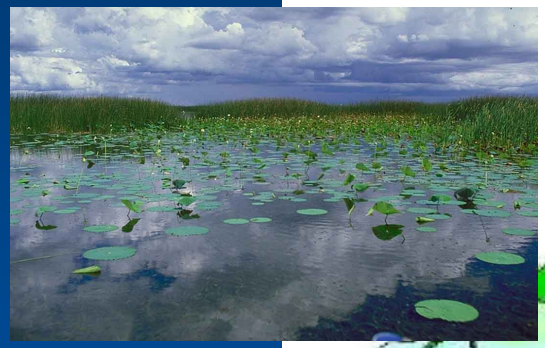
For Ecological sustainability: 12.5 to 15.0 ft-N

For HH Dike Stability: < 18.5 ft-NGVD

During 2005 : 18.02 ft-NGVD


Top of HH Dike (Elevation 32.3 – 45.6')
12-15' variation = healthy littoral and submerged grass beds
Deep Pelagic Zone (Elevation < 10')
Littoral Wetland (Elevation 11-15')
Submerged Grass Beds (Elevation 10-12')

Not to Scale



N

0 10 20

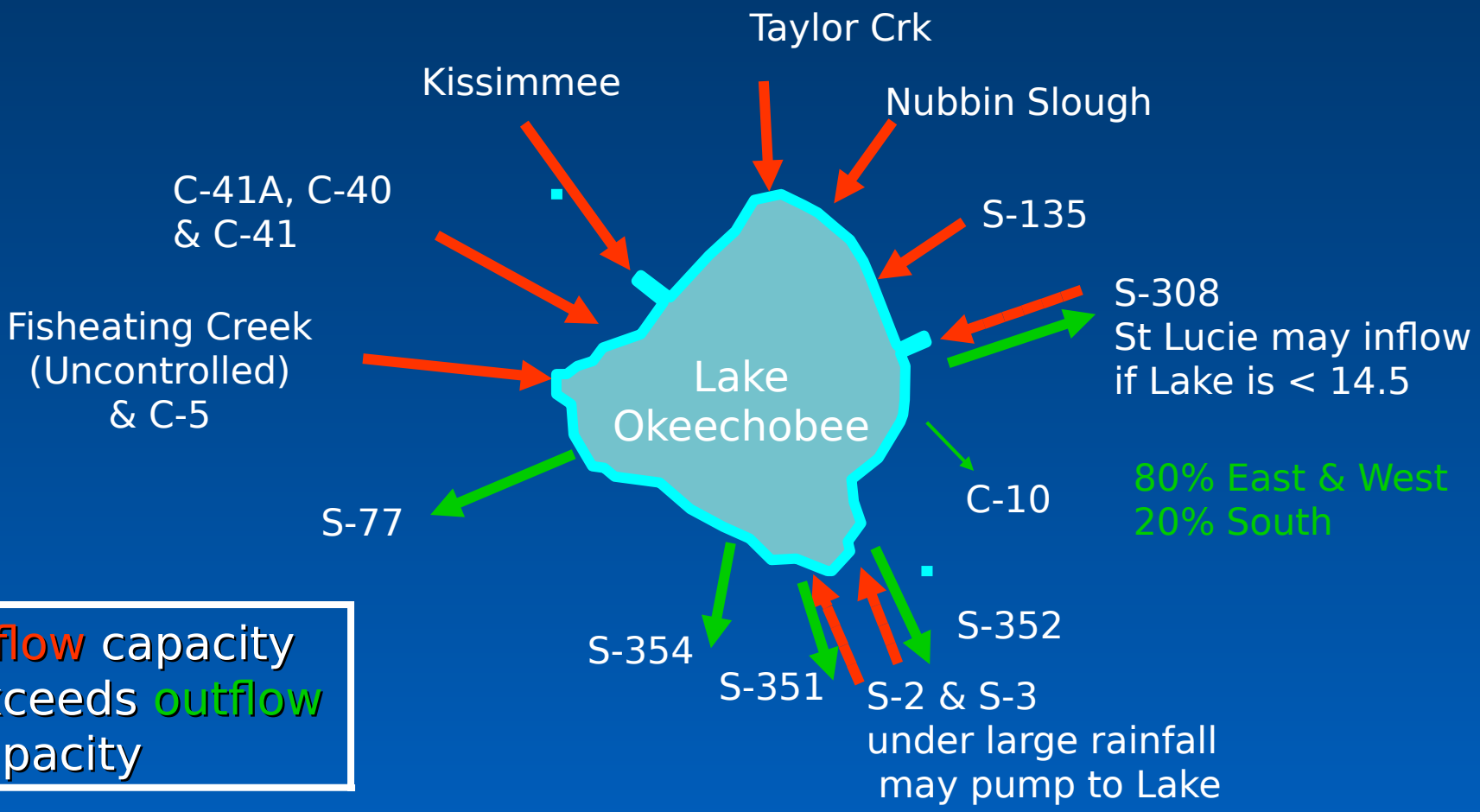
Kilometers

Pelagic Zone
(no plants)

Littoral Zone
(emergent, submerged, and floating plants)

Near Shore Zone
(submerged plant beds, *Chara*, bulrush)

Inflows & Outflows



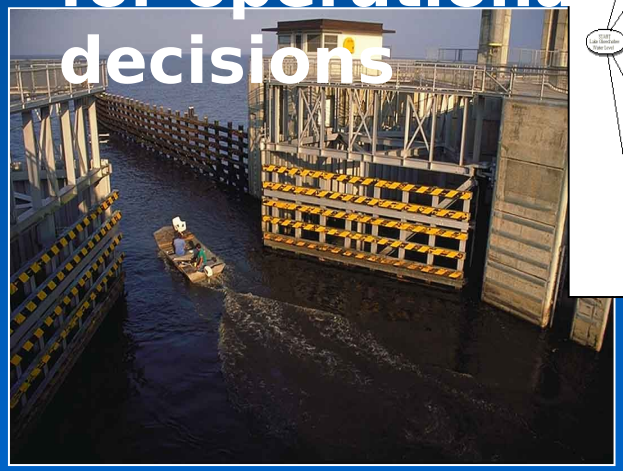
Inflow capacity exceeds outflow capacity

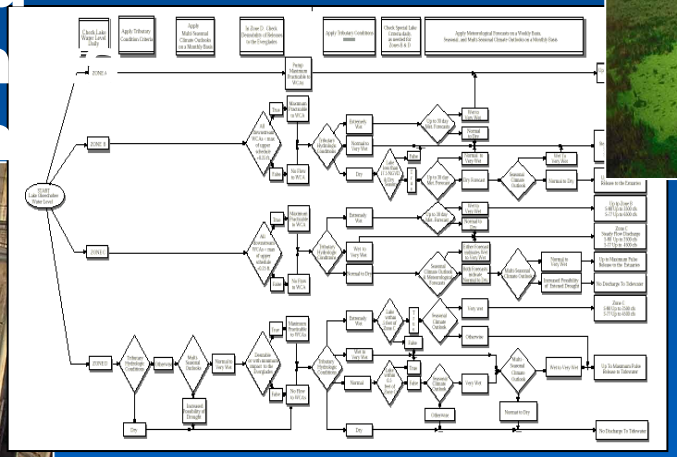
Lake Okeechobee's drainage basin covers more than 4,600 square miles

Revised Lake Okeechobee Operating Schedule

Lake Okeechobee Water Supply / Environmental Regulation Schedule (WSE)

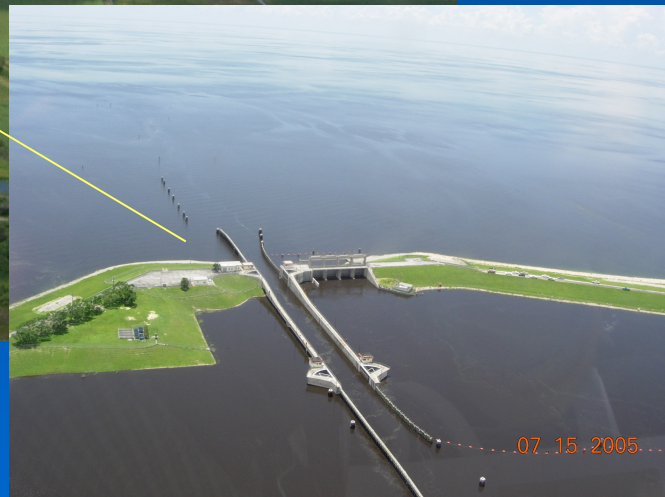
Incorporates tributary hydrologic conditions and climate foreca for operationa decisions





Utilizes pulse releases to mimic natural rainfall and runoff

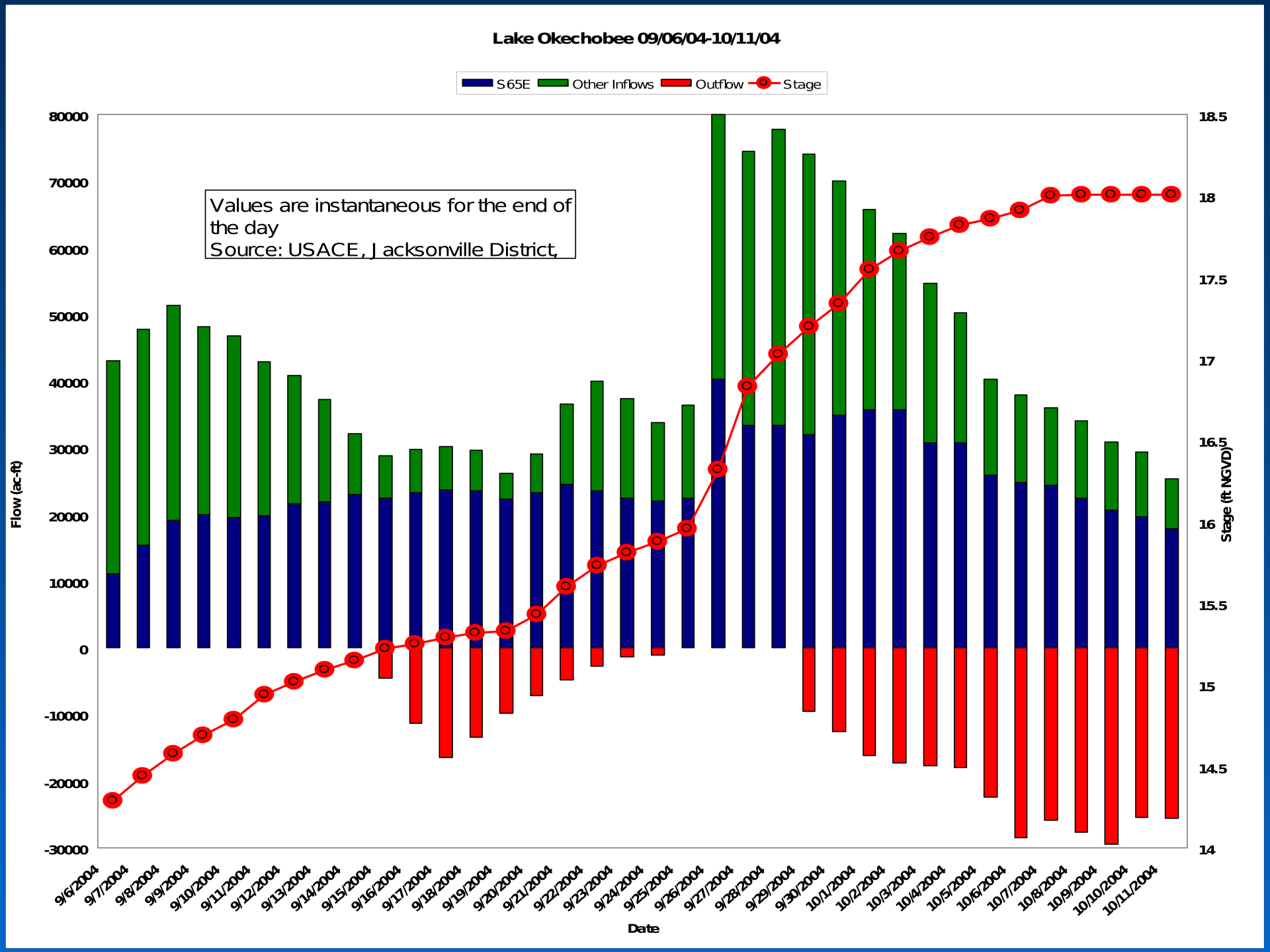
Looking west across the Port Mayaca showing immensity of Lake O relative to the outlet size.



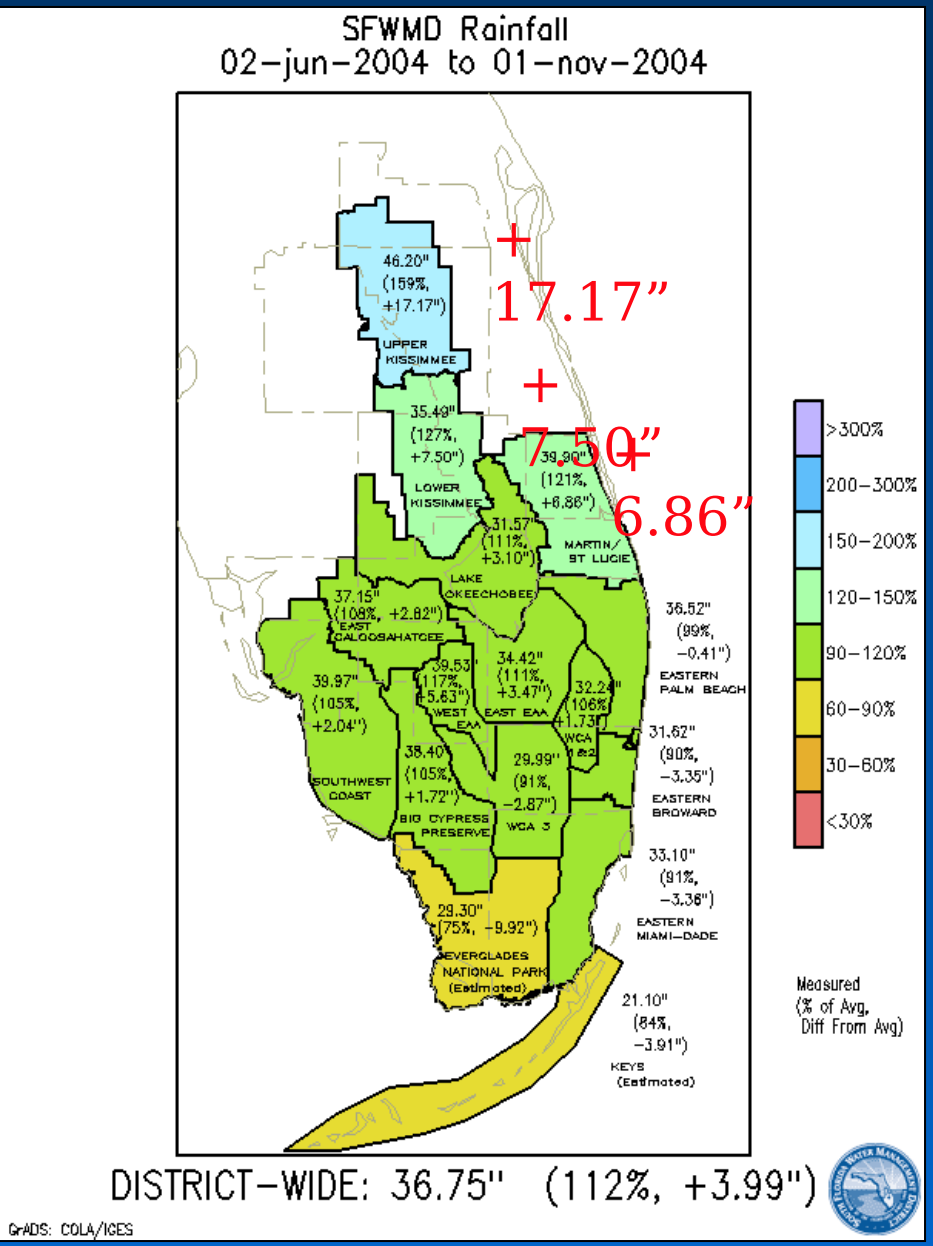
Port Mayaca S-308 Lock and Spillway (5600 cfs) 15July2005:1430

Gates at 7.0 ft, 4320, plus Lock open full (1300 cfs)

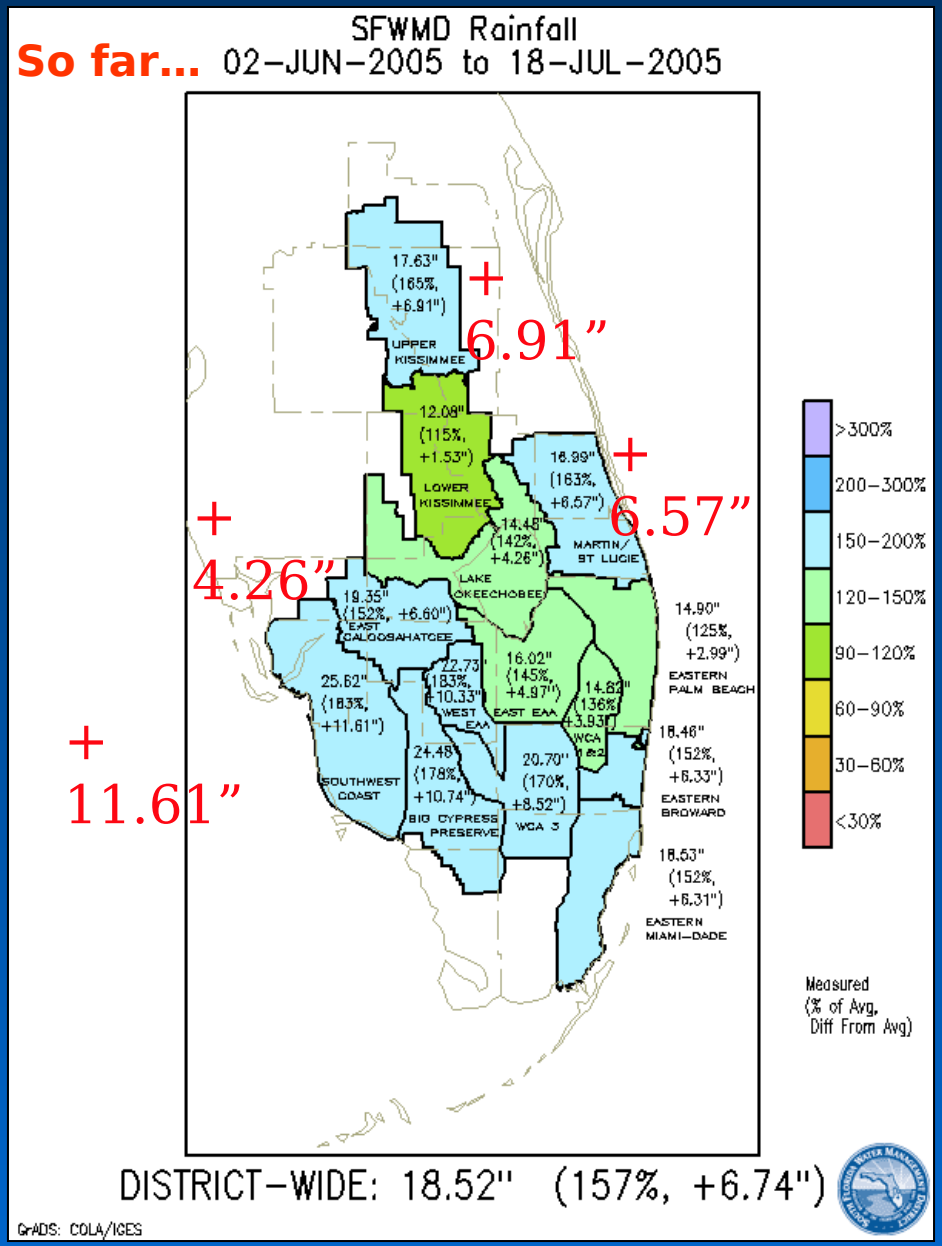
15JUL05 1430º 7.0 641 ³ 7.0 641 ³ 7.0 641 ³ 7.0 641 ³ 56 1756³ 4320³


Lake Okechobee 09/06/04-10/11/04
S65E
Other Inflows
Outflow
Stage
Values are instantaneous for the end of the day
Source: USACE, Jacksonville District,
Flow (ac-ft)
Stage (ft NGVD)
Date
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
-20000
-30000
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
9/6/2004
9/7/2004
9/8/2004
9/9/2004
9/10/2004
9/11/2004
9/12/2004
9/13/2004
9/14/2004
9/15/2004
9/16/2004
9/17/2004
9/18/2004
9/19/2004
9/20/2004
9/21/2004
9/22/2004
9/23/2004
9/24/2004
9/25/2004
9/26/2004
9/27/2004
9/28/2004
9/29/2004
9/30/2004
10/1/2004
10/2/2004
10/3/2004
10/4/2004
10/5/2004
10/6/2004
10/7/2004
10/8/2004
10/9/2004
10/10/2004
10/11/2004

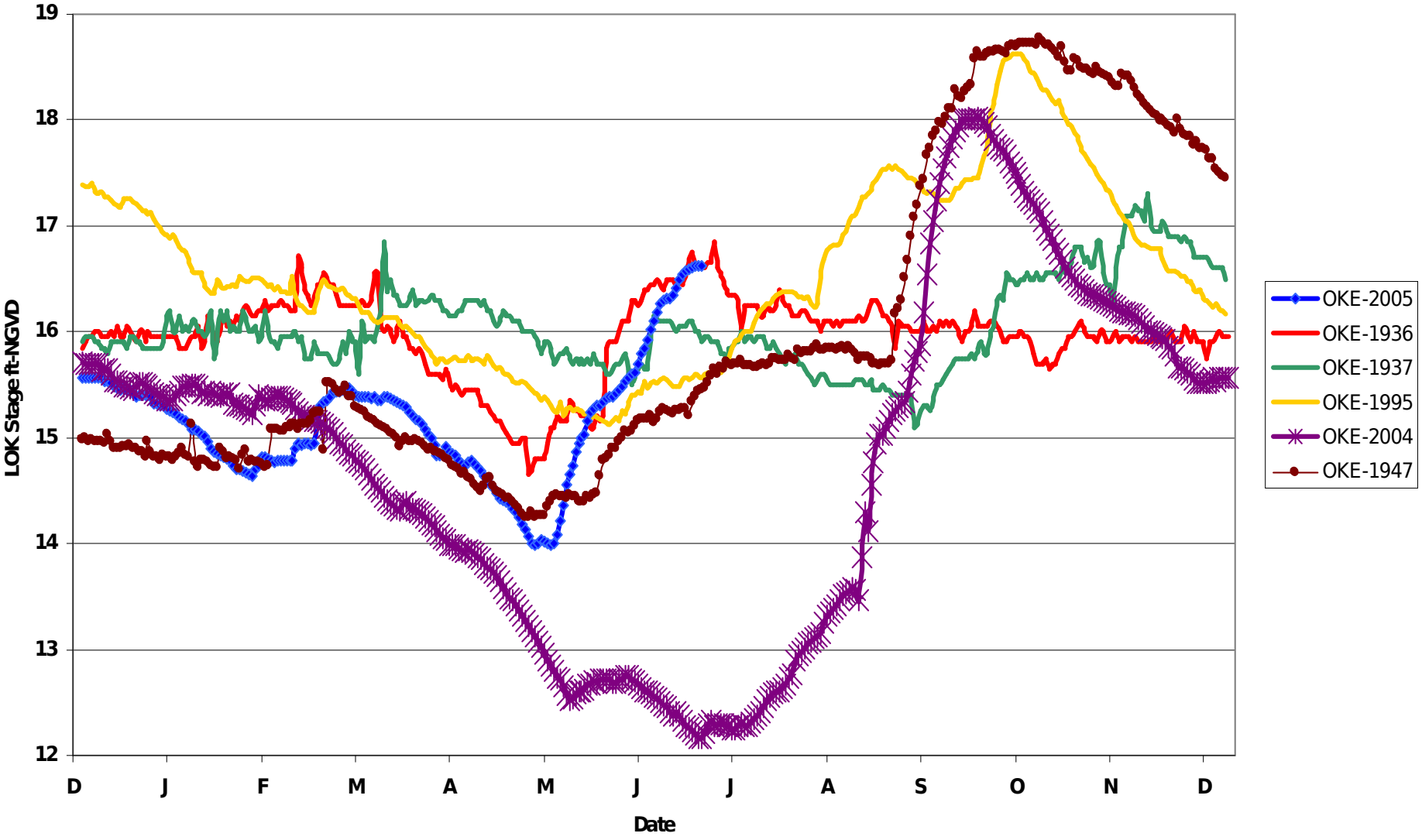
Wet Season 2004

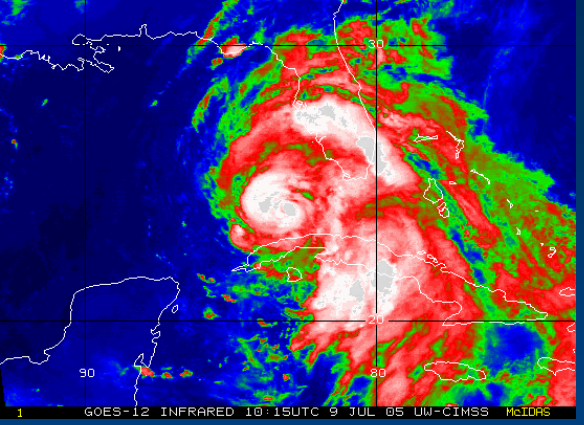


Wet Season 2005



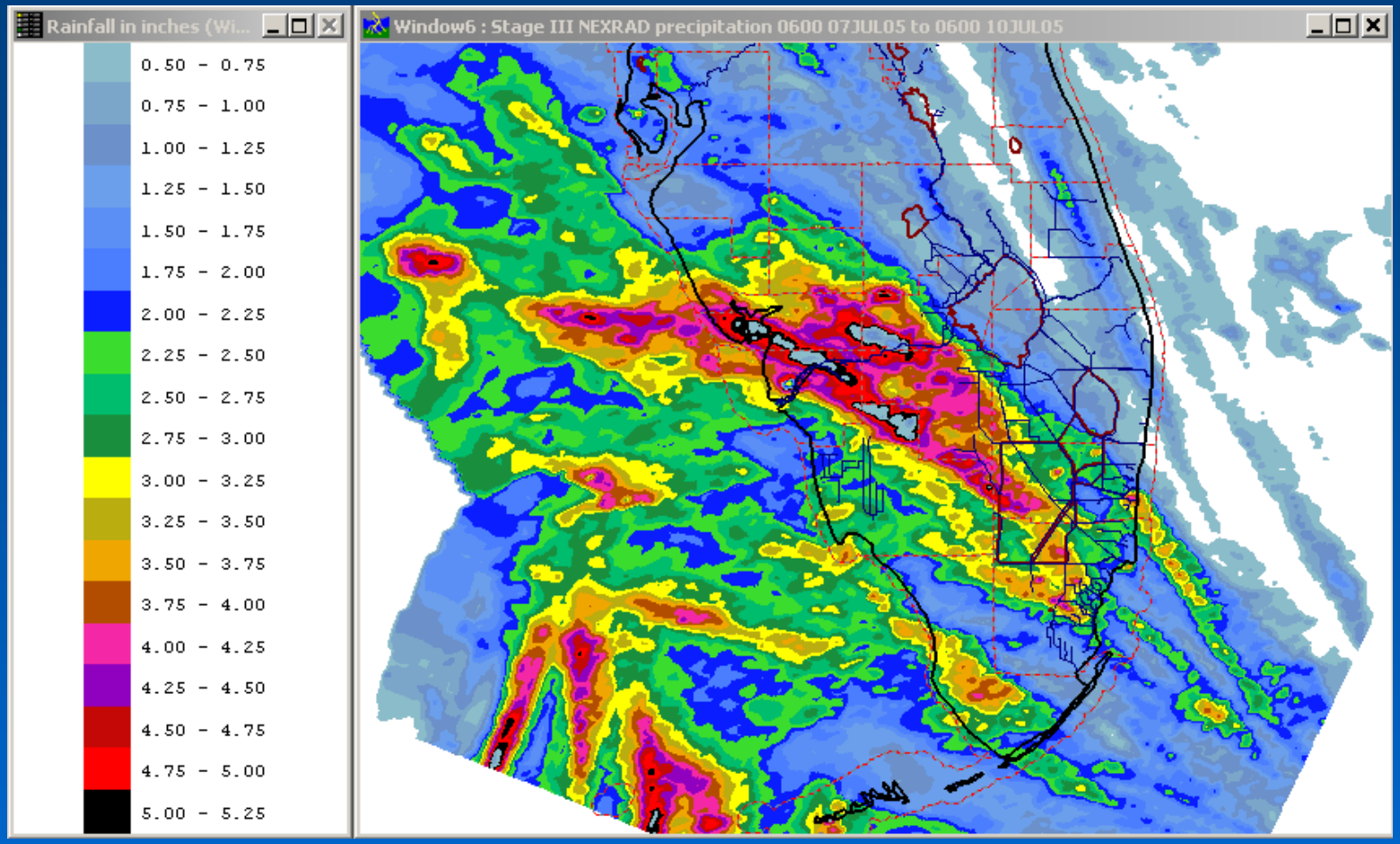
Lake Okeechobee Water Levels for Various Historical Years





Hurricane Dennis

9 July 2005



Looking north toward Stuart Inlet.

Plume of discharge is impressive

and alarming.

Questions?

http://fcit.usf.edu/florida/photos/envirmnt/sunset/sunset02.htm